Space Weather Technical Forecast

Issued on Tuesday, 16 April 2024 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Solar activity increased with M-flares likely and a slight chance of X-flares. Expected CME influence bring a chance of G1-G2/Minor-Moderate Geomagnetic storms into the 17-18th April.

Solar Activity: Activity is currently Moderate. The largest flare was an M4.0 at 15/1932UTC from AR3639. Background flux well within C-class levels. There are twelve sunspot regions currently visible on the disk. AR3634 in the northwest is the largest, though now classified somewhat more simply as Eho/Beta, with a slight reduction in flare risk. AR3639 in the northeast is the second largest and likely most complex region magnetically, presenting the largest current flare risk. The complex multi spot region in the southeast also remains a likely area for flare activity, with the small AR3637 retaining a delta spot within the leading portion. Continued slight growth visible across multiple spots within this southeast cluster of active regions, with two new areas identified. Remaining regions appear generally more stable with little change in recent hours.

Two CMEs were observed, the first leaving the northeastern quadrant of the Sun early 15th Apr, analysis suggests this may impact Earth late on the 17th or early 18th April, the second off the northwest later in the day is not currently expected to impact Earth although analysis remains ongoing.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE/DSCOVR at L1 were slow-ambient, around 330 km/s, a sudden increase around 15/1730UTC to 360km/s likely indicative of a weak CME arrival, with speeds remaining around 360-410m/s through the remainder of the period. Density was below average before increasing to average following the CME arrival and occasionally above average by the end of the period. The Interplanetary magnetic field (IMF) strength, Bt, was weak below 5nT until it increased to moderate after the CME arrival and remained so. The north-south component, Bz, becoming moderately negative following CME arrival, generally +3/-9nT. Phi angle was mostly negative (towards the Sun), becoming increasingly positive (away from the Sun) by the end of the period. Resultant geomagnetic activity was initially Quiet but increased to become Unsettled to Active (Kp 3-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at Background. High energy electron flux (greater than 2MeV) observed at GOES16 was Background to Moderate levels, with a peak of 387pfu observed at 15/1825 UTC. The associated 24-hour fluence remained below Active (1e8 integrated flux) with a value of 7.39e6 integrated pfu observed at 15/2359 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Overall Moderate solar activity is expected to persist, with occasional M-class flares likely and a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: Current conditions remain enhanced following CME arrival later on the 15th Apr, this expected to slowly ease during day 1 (16 Apr). Further CME influence

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

expected into days 2 and 3 (17-18 Apr) given the potential for glancing blows from CMEs that left the sun on the 14-15th Apr.

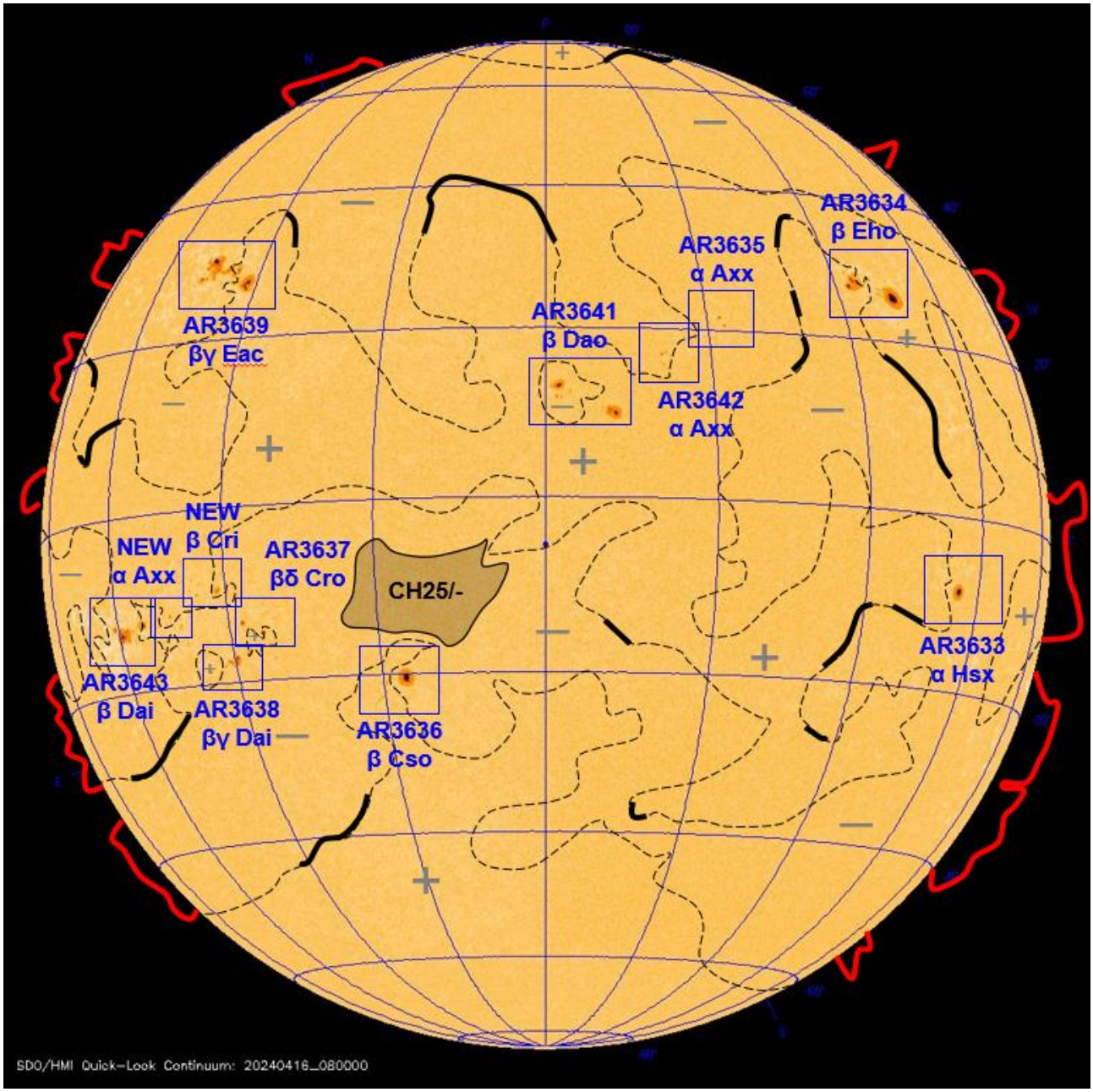
Geomagnetic activity is expected to be generally Unsettled to Active, with a slight chance of G1/Minor storm periods on day 1 (16 Apr) giving ongoing CME effects. Further CME influence expected into days 2-3 (17-18 Apr) seeing an increased chance of G1-G2/Minor-Moderate storm periods before conditions looks to calm into day 4 (19 Apr).

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES18 is expected to persist at background. High energy electron flux as observed by GOES-16 is expected to remain at generally background to moderate levels. The associated 24hr electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1. Solar Analysis Valid 16/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

CME influence expected to dominate the near Earth environment during the period. Current conditions remain enhanced following CME arrival later on the 15th Apr, this expected to slowly ease during day 1 (16 Apr). Further CME influence expected into days 2 and 3 (17-18 Apr) given the potential for glancing blows from CMEs that left the sun on the 14-15th Apr. The first of these from a joint flare and filament eruption in the southeast disc on 14 Apr. The second was associated with a CME eruption which left the northeastern quadrant of the Sun around 15/0549UTC. Modeling suggests these could impact Earth into early day 2 (17 Apr), with activity persisting into early day 3 (18 Apr) though with reduced confidence given potential interactions between the two features.

Geomagnetic activity is expected to be generally Unsettled to Active, with a slight chance of G1/Minor storm periods on day 1 (16 Apr) giving ongoing CME effects. Further CME influence expected into days 2-3 (17-18 Apr) from low confidence CME arrival seeing an increased chance of G1-G2/Minor-Moderate storm periods before conditions looks to calm into day 4 (19 Apr).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	40	30	10
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

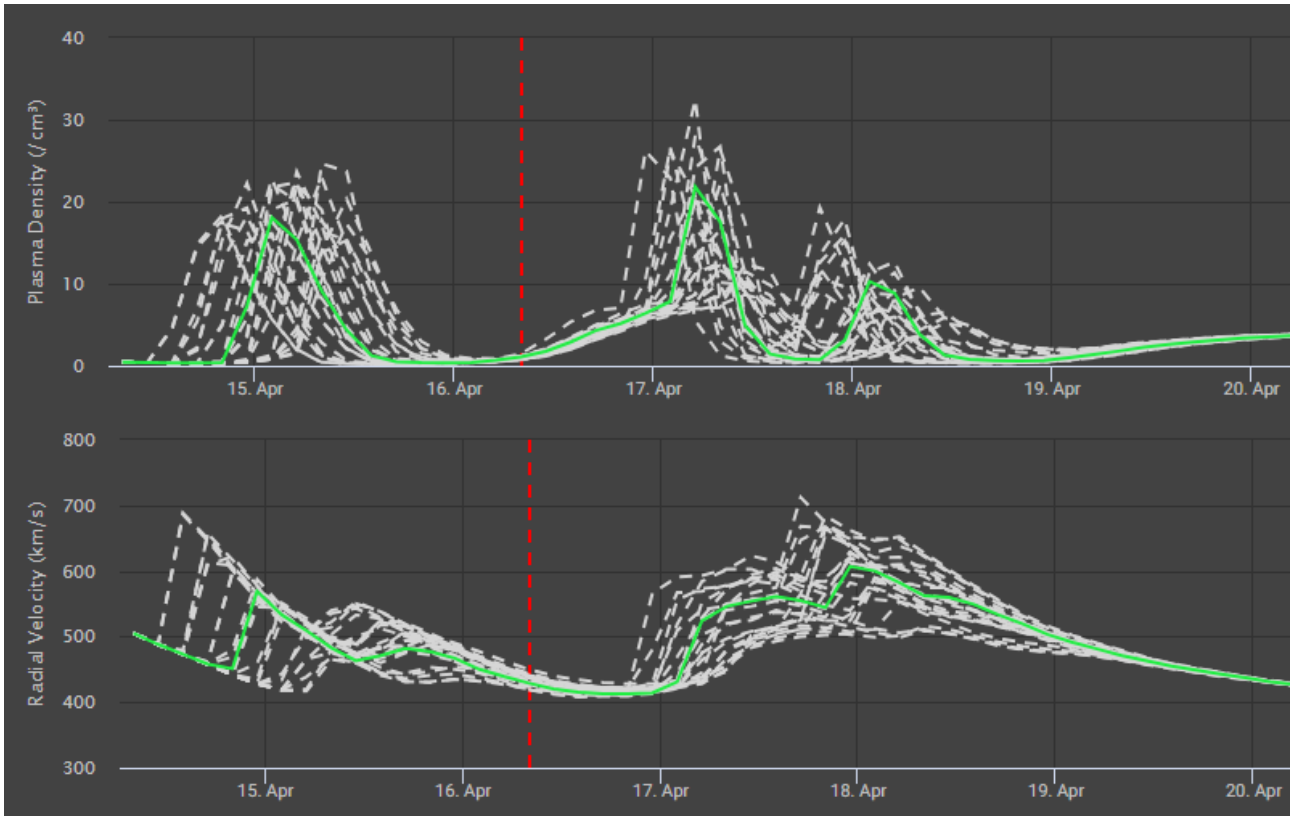
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1553	Partial	Flare + Filament	SE	680km/s	17/0600UTC +/-6 hrs	Glancing impact
15/0549	Partial	Flare + Filament	SE	640 km/s	18/0300 UTC +/- 6 hrs	Low confidence

Figure 2: Latest MOSWOC ENLIL Ensemble output

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

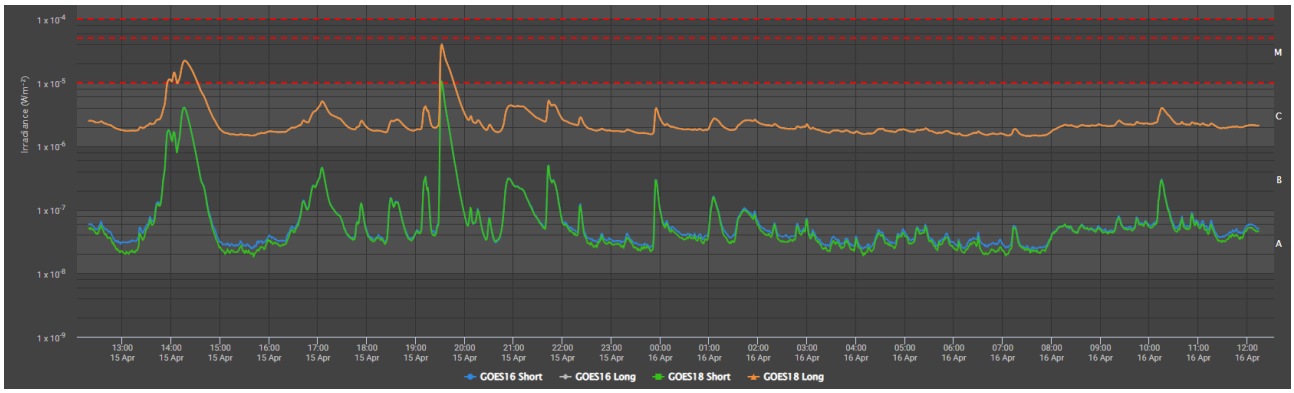
© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
Moderate activity is likely to continue as activity continues on an upward trend with twelve sunspot regions now on the disc and background flux well within the C-class level. Recent significant flares have originated from AR3634 in the northwest, although the region showing some signs of simplification. Flare risk looks to become increasingly dominated by eastern hemisphere regions in the coming days with the large and complex AR3639 in the northeast and the highly complex southeast seeing multiple small spots developing. Further regions also forecast to rotate around the eastern limb early in the period, one of which the likely source of recent CME activity.

Overall Moderate activity is expected to persist, with occasional M-class flares likely and a slight chance of isolated X-class flares and the risk remaining consistent through the period pending further developments.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: Latest 24hr GOES16/18 X-Ray trace



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
High energy proton flux as observed by GOES18 has persisted at background levels and is expected to generally remain so. There is a slight chance of the observed flux increasing in response to any notable flares however, primarily from AR3634 with this region moving towards the western limb through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

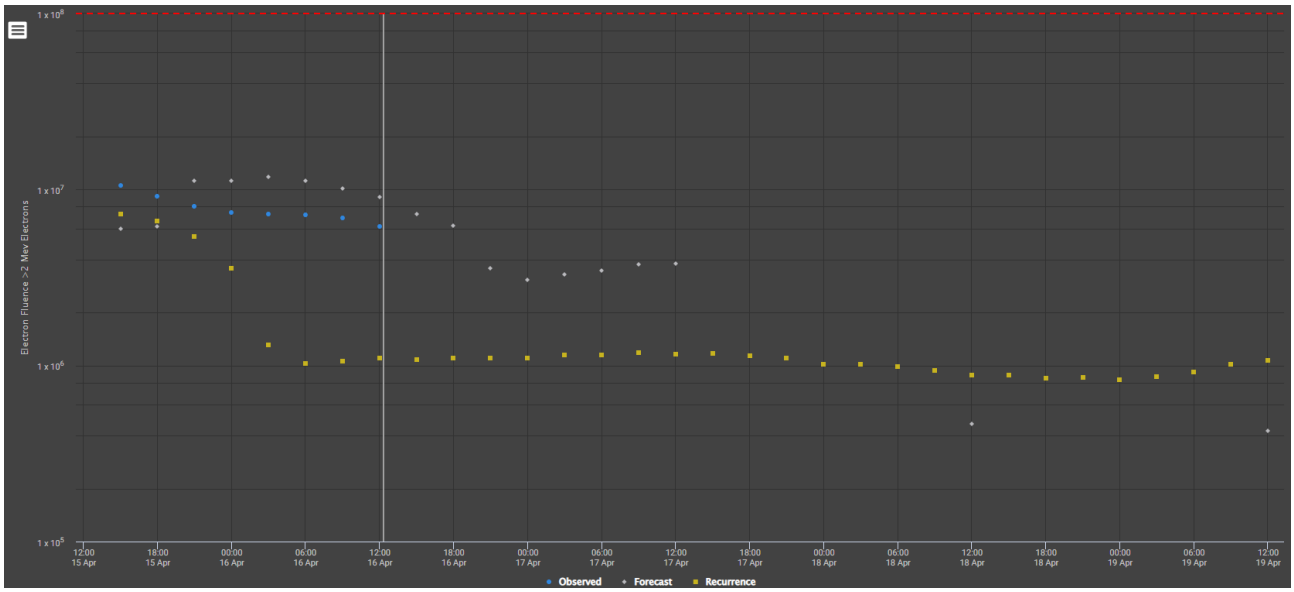
© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels with likely ongoing geomagnetic activity expected to generally suppress values in the coming days.

The associated 24hr electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, with current REFM output broadly accepted as good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.